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# What guidance is there on portion size for feeding preschool-aged children (1 to 5 years) in the United Kingdom and Ireland? A systematic grey literature review

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## Summary

Large portion sizes of food can lead to excessive energy intake and weight gain in young children. Although portion size guidance is available, parents are often unaware it exists. Our systematic grey literature review aimed to identify the portion size guidance resources in the United Kingdom and Ireland, aimed at users (e.g., parents and childcare providers) responsible for feeding preschool-aged children. We describe who the resources are aimed at, how they are informed and whether the recommended portion sizes are consistent across resources. Resources were identified via advanced Google searches, searching reference lists and contacting experts. Resources that provided quantifiable portion size information (e.g., grammes) were included. Portion sizes (g) were extracted and energy equivalents (kcal) were calculated. Portion sizes were analysed by food group and by eating occasion. Twenty-two resources were identified. Median portion sizes were consistent across resources for fruit (40 g [IQR = 40–50]) and vegetables (40 g [IQR = 30–40]). Variability was observed in portion size and/or energy content for dairy (60 g [IQR = 25–93]), protein (72 kcal [IQR = 44–106]) and starchy (41 g/71 kcal [IQR = 25–80/56–106]) food groups. The range in size of an average eating occasion was large (90–292 g). This review identifies resources that could help caregivers to choose appropriate portion sizes for preschool-aged children but also highlights how future resources could be improved.

## KEYWORDS

food, guidance, portion size, preschool

**Abbreviations:** AfC, Action for Children; ALSPAC, Avon Longitudinal Study of Parents and Children; BEY, Bristol Early Years; BNF, British Nutrition Foundation; CWT, Caroline Walker Trust; DoH, Department of Health; DRV, Dietary Reference Value; ENHS, Centre for Exercise, Nutrition and Health Sciences; FSNT, First Steps Nutrition Trust; HFHS, high fat, high sugar; HSE, Health Service Executive; IFB, Irish Food Board; IQR, interquartile range; ITF, Infant & Toddler Forum; MJ, megajoule; NDNS, National Diet and Nutrition Survey; NDS, Nutrition and Dietetic Services; NHS, National Health Service; PDF, Portable Document Format; PH, Public Health; PHE, Public Health England; PRISMA, Preferred Reporting Items for Systematic Reviews and Meta-Analyses; Q–Q plots, Quantile–quantile plots; SFT, School Food Trust; UK, United Kingdom; URL, Uniform Resource Locator; USA, United States of America; WHO, World Health Organization.

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## 1 | BACKGROUND

Childhood obesity prevention is a current worldwide public health priority.<sup>1</sup> Data collected in 2018/2019 show that 22.6% of 4- to 5-year-old children in England were classified as overweight or obese, with similar rates observed in the rest of the United Kingdom.<sup>2</sup> Several dietary factors, including larger portion sizes, are likely to contribute to childhood obesity.<sup>3</sup>

Research suggests that infants (0–1 years) are able to self-regulate their energy intake.<sup>4</sup> However, this self-regulation mechanism seems to diminish with age,<sup>4, 5</sup> making young children increasingly susceptible to factors such as parent feeding practices or environmental cues, which may result in overconsumption. Experimental evidence has shown that serving young children (3–6 years) larger portions of palatable energy-dense foods at a meal (e.g., macaroni cheese, cereal and chicken nuggets) results in a higher energy intake.<sup>6, 7</sup> Evidence shows that young children consume larger amounts of the manipulated foods, without a compensatory decrease in the intake of other foods, leading to greater energy intake during a single meal.<sup>8</sup> This effect has been shown to be sustained over several days.<sup>9</sup> Studies have also shown that increasing portion sizes of healthier foods such as milk and fruit alongside other foods results in increased consumption of these foods, without increasing total energy intake (kcal) of the meal.<sup>10, 11</sup> However, this may not be the case for all foods; serving vegetables alongside a downsized high energy-dense food did not lead to increased vegetable consumption and therefore reduced total meal energy intake.<sup>12</sup> Therefore, to manage overall energy intake, it is important to consider the combined effect of altering portion sizes of different foods because eating occasions typically represent a mixture of many foods rather than a single one. Longitudinal evidence has shown that larger total meal sizes consumed at 21 months were associated with faster growth rate above the average, from 2 to 5 years, suggesting that meal size (resulting from the combination of many foods) may be a critical driver of weight gain.<sup>13</sup>

We know that children require energy for growth and development and that, as children age, they require more energy due to an increase in body size.<sup>14</sup> Increasing portion size as children age is an effective way of meeting these increasing energy intake demands. However, when portion sizes are consistently providing energy above requirements, this may lead to overconsumption and excess weight gain.<sup>8</sup> Thus, age-specific portion size guidance may help to strike a healthy balance.

The School Food Trust (SFT), a former English charity that focused on promotion of healthy eating in children, was commissioned by the Department for Education to review the current status of food and drink provision for early years (1–5 years) in 2010. They stated that early years childcare providers and practitioners, local authorities and parents all expressed the need for clear and practical guidance about healthy food and drink for young children, including guidance on portion sizes.<sup>15</sup> As a result of this work, voluntary food and drink guidelines for early years childcare providers in England were created. Public Health England subsequently

commissioned The Children's Food Trust (formerly the SFT) to revise these guidelines in 2016 as part of the United Kingdom governments' childhood obesity strategy to support early years settings.<sup>16</sup> In addition, an earlier published nongovernmental childhood obesity strategy also proposed making more portion size guidance available to parents and health professionals, as well as early years settings.<sup>17</sup> Despite this, recent qualitative evidence suggests that some parents in the United Kingdom are still unaware of any existing guidance but do want guidance on appropriate portion sizes for their preschool-aged children.<sup>18</sup>

Evidence-based, accessible guidance that is useful for all (but especially those in greatest need in terms of inequalities and obesity risk) is required before implementation of strategies can be carried out.<sup>19</sup> Portion size guidance could support those feeding preschool-aged children in order to manage children's age-specific energy needs and ensure dietary and nutritional adequacy (e.g., vitamin sufficiency, avoiding excessive salt), which are vital for general health. Guidance can usefully indicate balance of foods and combination of foods that are known to promote good health and adequate energy intake in the early years. Therefore, identifying and scrutinizing current guidance aimed at those responsible for feeding preschool-aged children should be conducted on a regular basis, to assess whether it is fit for purpose for the population they serve.

Previous research has reviewed food and drink guidelines and policies aimed at feeding preschool-aged children in the United Kingdom<sup>20</sup> and Ireland.<sup>21</sup> These critical reviews identified and discussed voluntary and mandatory guidelines in the United Kingdom and Ireland, however, did not use systematic search strategies to do so. Both studies focused on guidance for childcare providers (e.g., preschools and nurseries) only and did not include guidance for others responsible for feeding preschool-aged children (such as parents). Both studies discussed guidance published in or before 2015, some of which has since been updated. Therefore, a systematic review that attempts to identify all the current portion size guidance available in the UK and Ireland for feeding preschool-aged children is warranted. We conducted a systematic grey literature review that aimed to identify, describe and compare portion size guidance for those responsible for feeding preschool-aged children (1–5 years). The review focused on four research questions:

- 1 What resources exist in the United Kingdom and Ireland that provide portion size guidance for feeding preschool-aged children, aimed at nonacademic audiences?
- 2 Who is the target audience for the guidance?
- 3 How was the guidance informed?
- 4 How consistent are portion size recommendations across guidance resources?

## 2 | METHODS

A systematic grey literature review was conducted. Grey literature can be defined as publicly available, open source information, which is

not controlled by commercial publishers.<sup>22</sup> A protocol was developed in advance and registered on the international prospective register of systematic reviews (PROSPERO), with registration number: CRD42019127526. The review followed the PRISMA 2009 reporting guidelines<sup>23</sup> (Table S1). Four search strategies listed below were conducted to identify potentially relevant resources, which provided guidance about portion sizes for preschool-aged children (1 to 5 years) in the United Kingdom and Ireland.

## 2.1 | Search strategies

- 1 Internet search: The internet search engine Google (<https://www.google.com>) was used to search for relevant resources. Three Google searches were conducted. The first was an advanced search and included all of the keywords and phrases: ('portion size' OR 'meal size' OR 'serving size' OR portion\* OR food OR diet OR dietary OR nutrition OR nutritional OR menu OR recipe OR meal) AND (preschool\* OR preschool OR 'early years' OR 'young children' OR 'childcare' OR '1 to 5 years' OR 'age 1 to 5' OR '1 to 4 years' OR 'age 1 to 4') AND (guidance OR guidelines OR guide OR policy OR advice OR information) AND ('United Kingdom' OR UK OR England OR Wales OR Scotland OR Ireland). The second search (portion size, guidance, preschoolers and UK) and third search (nutrition, guidelines, 1 to 5 years and United Kingdom) were broader to ensure all possible resources could be identified. All Google results were screened, and those judged to be potentially relevant were saved for full-text assessment. All results obtained were scanned for relevance based on the title, the contents page (if available) and the source of information (i.e., excluded non-UK websites and duplicate information) by two researchers (AP and AD). All potentially relevant resources were read in full by AP and AD to assess eligibility for inclusion, and disagreements were resolved through discussion. Searches were conducted up to and including 28 February 2019.
- 2 Suggestions from experts and academics working in the field: Seven experts and academics were identified through personal contacts of the authors and contacted directly to suggest websites or resources they thought may be relevant to the literature search. This search strategy was chosen as it has been successful in identifying relevant grey literature in previous reviews.<sup>24, 25</sup> Experts included one dietician and senior health promotion specialist, one dietician/public health nutritionist, one senior nutrition scientist and one nutrition communications manager. Experts and academics were contacted because they all had knowledge in early years nutrition or public health guidance. Data saturation was met after seven meetings with experts and academics, which occurred between December 2018 and February 2019.
- 3 Open Grey: Open Grey (<http://www.opengrey.eu/>) is an online system for identifying grey literature in Europe. The same keywords and phrases as the internet search were used to conduct the

search. All results were scanned, and those thought to be relevant were saved for follow-up. Searches were conducted by AP up to and including 25 February 2019.

- 4 Reference lists from relevant resources: After identified resources were read in full to assess eligibility, a search for additional resources was conducted by screening all reference lists from the included resources. Reference lists were first screened by title, contents page and source, and those deemed relevant were read in full to assess eligibility for inclusion. Searches were conducted by AP and AD up to and including 15 March 2019

## 2.2 | Data management

All resources eligible for inclusion were stored in an Excel file with Uniform Resource Locator (URL) and Portable Document Format (PDF) links. The number of resources identified, screened, assessed for eligibility, excluded and included for review, duplicates and the dates these processes occurred were stored by both reviewers in an Excel file.

## 2.3 | Eligibility criteria

After initial screening, resources saved for follow-up were read in full to decide on those to be included for review. Resources were included if freely and publicly available and excluded if aimed only at academic audiences. These criteria were set to ensure that only resources that were aimed at those who are involved in or advise on feeding preschool-aged children (e.g., parents, childcare providers and healthcare professionals) were included. Childcare providers included but were not limited to nurseries, preschools, playgroups, childminders, nannies, toddler groups, crèches and family centres. Healthcare professionals included but were not limited to health visitors, paediatricians, midwives, dieticians, nutritionists, public health teams, general practitioners and community food workers.

Resources were included for review if reported examples of weight- or calorie-based portion size guidance. For example, if they presented recommended number of grammes for food items. Resources were excluded if only generic advice on portion sizes was provided (e.g., a portion should be the size of a fist) or did not provide portion sizes for a range of foods that could be combined to make a meal. This was to enable quantifiable comparisons of portion sizes between the resources. Resources were included if aimed at preschool-aged children (defined here as age 1–5 years) and excluded resources aimed at children with disease or allergies. Inclusion was limited to resources published in the United Kingdom and Ireland to limit potential cultural differences in typical food consumption, which would make comparisons between resources difficult. Resources were excluded if they had directly duplicated information from another resource or website (e.g., a news article or blog site posting another organizations' information). There were no language or date restrictions.

## 2.4 | Data extraction

Descriptive information for each of the included resources was extracted; name of resource, publisher (name of organization), URL, funder, date of publication, the target country and audience, the age range of children, how the guidance were created and informed and whether portion size guidelines were for individual food/drinks or meals. All resources were checked for previous and updated editions, and the most up-to-date resource was included in the review. All authors (or contacts from the organizations who published the resource) were contacted via email to provide more detailed information about how the resources were created and informed. Contacts were followed up by telephone or email up to three times if they did not respond or if further information was required.

Portion sizes of all foods and drinks in each resource were extracted as well as their associated eating occasion (breakfast, main meal [lunch or dinner], snack, dessert and none [i.e., general recommendation not specific to an eating occasion]). Snacks were defined according to the guidance resource and therefore could include both low and high energy density foods. The units used to present the portion sizes (e.g., grammes, household measures) were also extracted. This data was used to summarize and compare portion sizes of individual foods/drinks and of eating occasions. Water was not extracted because not all resources provided this as an amount and therefore could not be compared across resources.

To aid comparability across resources, when portion sizes of foods/drinks were reported in household measures (e.g., spoons, cups, number of foods and slices), these were converted to grammes or millimetres using the 'Food diary coding Exercise, Nutrition and Health Science (ENHS) DietPlan 6 manual' (Centre for ENHS, unpublished data, 2015), which was based on the 'Intermap UK' and 'ALSPAC' study food code books<sup>26, 27</sup> developed to aid coding of diet diaries in children and adults. When portion sizes could not be converted, these were coded as missing. Weights were rounded up to the nearest gramme. Data extraction was conducted by the primary researcher (AP). The second reviewer independently extracted 10% of the data, and this was compared between reviewers to minimize bias and inaccuracy. There was a 1.5% discrepancy between the two reviewers, which was resolved through discussion. Therefore, it was decided that no further duplicate data extraction was required. Data were stored in an Excel file.

## 2.5 | Assessment of quality and risk of bias

A formal framework for assessing quality and risk of bias was not used, as one is not available for guidance resources. Various aspects such as publication date, publisher, funder and format of the resources were reported descriptively, and information about the evidence and processes used to develop the resources were collected.

## 2.6 | Analysis and reporting

A narrative review of the included resources is presented. Quantitative analyses were conducted to assess the number of food and drink items included and average portion sizes of food/drinks across food groups and meals across eating occasions. Two separate analyses were conducted: one for resources that recommended portion sizes for individual food/drinks and one for resources that recommended portion sizes within meals, as these were distinct methods of presentation in the collated resources. Average portion sizes of meals across eating occasions were calculated to summarize the data and enable comparison between resources presenting with different formats, similar to previous research.<sup>13</sup>

Graphical methods (histograms and Q-Q plots) were used to assess normality of the extracted data. Analyses were conducted in Stata 15 (Statacorp, Texas). Results were presented as a median and interquartile range, owing to skewed distributions. To present a meaningful overview of the extracted data, food/drink items and portion sizes were analysed by broad food groups based on the Eatwell Guide (dairy, fruit, high fat/high sugar [HFHS], protein, starchy and vegetables).<sup>28</sup> Each food/drink item extracted was assigned a food group, in line with how it was grouped within the resource. Where food/drink items had not been assigned a food group within the resource, the National Diet and Nutrition Survey (NDNS) database,<sup>29</sup> which uses the DINO dietary assessment system<sup>30</sup> was used to decide which food group to allocate to. Energy equivalents (in kcal) for each portion size were also calculated using the NDNS nutrient database<sup>29</sup> by assigning each extracted food/drink to a food code. This process was carried out independently by two authors (AP and CS), and any disagreements were resolved through discussion with a third author (LJ).

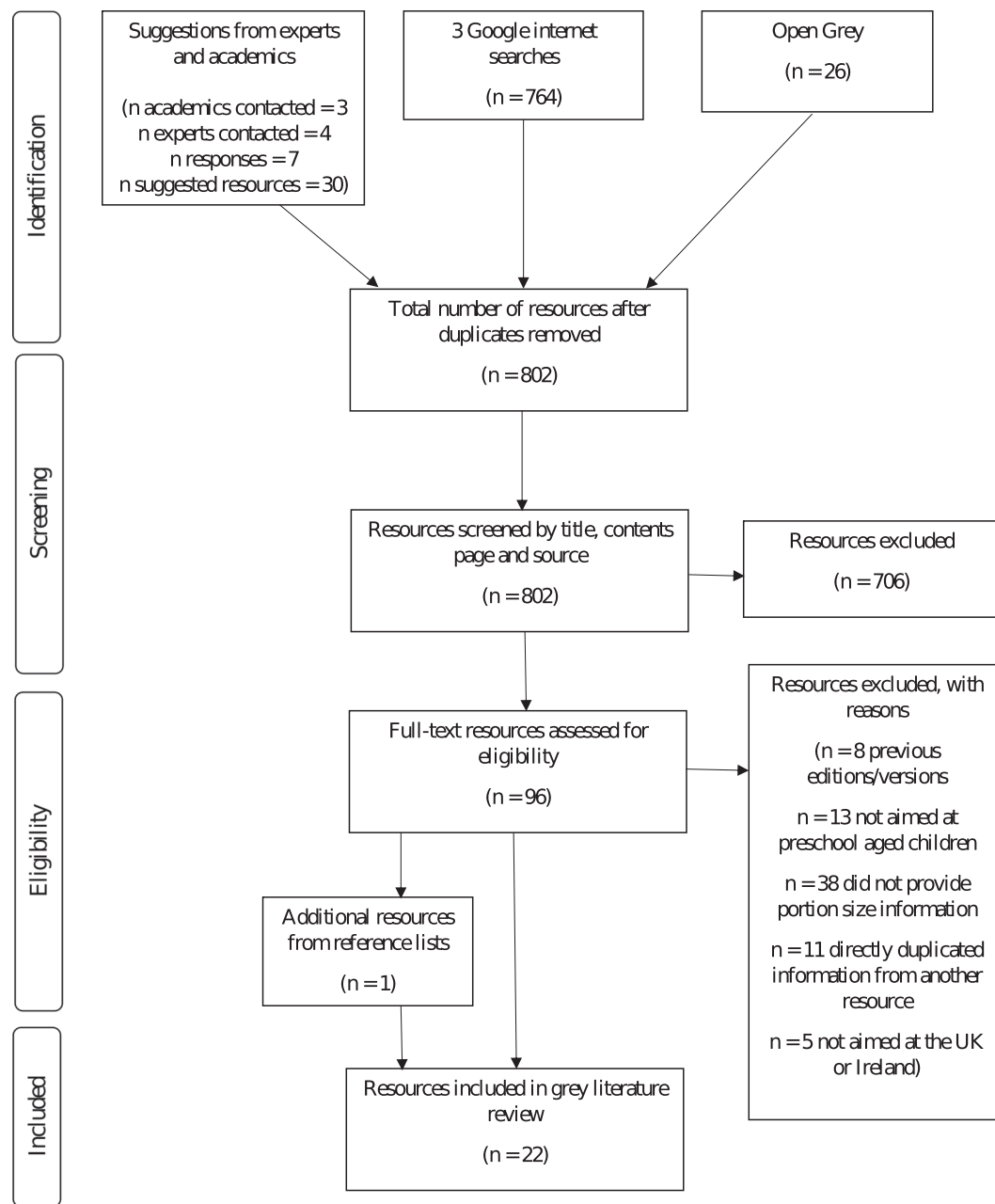
## 3 | RESULTS

### 3.1 | Search results

Figure 1 presents a study flow diagram, which was created by adapting the PRISMA 2009 Flowchart<sup>23</sup> and a previous grey literature review flow diagram.<sup>25</sup> Figure 1 illustrates the number of results yielded from the four search strategies. Of the initial results obtained and screened from experts ( $n = 30$ ), Google ( $n = 764$ ) and Open Grey ( $n = 26$ ) searches, full-text assessment was conducted for 96, and 22 resources were included in the review. Resources were most frequently excluded at the full-text assessment stage due to not providing portion size information ( $n = 38$ ). For example, some resources only provided generic advice about feeding practices or types of food to feed preschool-aged children, without providing portion sizes.

### 3.2 | Descriptive information

Table 1 presents descriptive information about each of the 22 guidance resources. All resources were found online as a website page,



**FIGURE 1** Study flow diagram

document or online leaflet. The oldest dated resource was published in 2004 by the Department of Health and Children in Ireland. Six resources were most recently published in 2018 (see Table 1).

### 3.3 | Who the guidance is aimed at

Table 1 presents information about who the guidance resources were aimed at. Ten resources (45%) were aimed at more than one target audience. Resources were most commonly aimed at childcare providers (13/22, 59%), which tended to present portion sizes within meals (9/13, 69%). Parents/carers were stated to be the target audience in seven (31%) of the resources. However, only four (18%) were

solely aimed at parents, and these tended to present portion sizes of individual foods (3/4, 75%). One (5%) resource was aimed at pre-school inspectors. For most resources, portion sizes were recommended for children aged 1–4 (12/22, 54%) or 1–5 (6/22, 27%) years. The Health Service Executive (HSE) resource presented a daily meal plan recommendation for a 5-year-old boy. The Bradford Nutrition and Dietetics Service (NDS) presented separate portion sizes for 1 year, 2–3 years and 3–5 years. The Start4Life 'recipes and meal ideas' website page specified that the portion sizes were recommended for children aged 12 months+. Nine resources provided guidance for the United Kingdom (41%), six for England (27%), four for Ireland (18%), one for Northern Ireland (5%), one for Wales (5%) and one for Scotland (5%).

**TABLE 1** Descriptive information for the 22 included guidance resources

Publisher/date	Type of organization/funding	Country	Target audience	Age range (years)	Presented as portion sizes of individual food/drinks or meals		Presented as food groups or eating occasions		
							Food groups		Eating occasions
					Individual food/drinks	Meals	S, FV, D, P	HFHS	
Action for Children (AfC)/2017	NGO	England	CP, HP	1–4	X	X	X	X	X
Bristol Early Years (BEY)/2018	GO	England	Parents	1–4	X		X		
British Nutrition Foundation (BNF)/2014	NGO <sup>a</sup>	Britain	Parents	1–3	X		X		
Bord Bia Irish Food Board (IFB)/2018	CO	Ireland	Parents	1–5	X		X		
Bradford Nutrition and Dietetics Service (NDS)/2013	CO	England	Not stated	1, 2–3 & 3–5	X		X	X	
Caroline Walker Trust (CWT)/2015	NGO	United Kingdom	CP, HP, Parents	1–4	X	X	X	X	X
Department of Health (DoH) East Midlands/2010	GO	England	CP	1–4	X		X		
Department of Health (DoH) Ireland/2004	GO	Ireland	CP, PI	1–5	X		X		
First Steps Nutrition Trust (FSNT)/2015	NGO	United Kingdom	CP, HP	1–4		X			X
First Steps Nutrition Trust (FSNT)/2017	NGO	United Kingdom	CP, HP	1–4		X		X	X
First Steps Nutrition Trust (FSNT)/2018	NGO	United Kingdom	CP, HP	1–4		X			X
First Steps Nutrition Trust (FSNT)/2018	NGO	United Kingdom	CP, HP	1–4	X		X		
HSC Public Health (PH) Agency/2018	GO	Northern Ireland	CP	1–5	X		X		
Health Service Executive (HSE)/2016	GO	Ireland	General Public	5		X	X		
Infant & Toddler Forum (ITF)/2015	NGO <sup>a</sup>	United Kingdom	CP, HP	1–4	X	X	X	X	X
Infant & Toddler Forum (ITF)/2016	NGO <sup>a</sup>	United Kingdom	Parents, HP	1–4	X		X	X	
Leicestershire Nutrition and Dietetics Service (NDS)/2017	CO	England	HP	1–5	X		X	X	
National Health Service (NHS) Health Scotland/2018	GO	Scotland	CP	1–5	X		X		
Public Health England (PHE)/2017	GO	England	CP	1–4		X		X	X



TABLE 1 (Continued)

Publisher/date	Type of organization/funding	Country	Target audience	Age range (years)	Presented as portion sizes of individual food/drinks or meals			Presented as food groups or eating occasions			
					Individual food/drinks	Meals	S, FV, D, P	Food groups		Eating occasions	
								HFHS	B	L/D	S
Safefood/2013	GO	Ireland	CP, Parents	Not stated	X	X	X	X	X	X	X
Start4Life/unknown	GO	United Kingdom	Parents	12+ months		X				X	X
Welsh Government (Gov)/2018	GO	Wales	CP	1–4		X			X	X	X

Abbreviations: B, breakfast; CP, childcare providers; CO, commercial organization; D, dairy; FV, fruit and vegetables; GO, government organization; HFHS, high fat, high sugar; HP, healthcare professionals; L/D, lunch/dinner/main meal; NGO, nongovernment organization; P, protein; PI, preschool inspectors; S, snacks; S, starchy foods.

\*Funded by an educational grant from Danone Nutricia, Early Life Nutrition; however, the resources remain independent of its commercial interests.

### 3.4 | Presentation of portion size guidance

Table 1 reports how portion sizes were presented in each of the 22 guidance resources. Fifteen (68%) resources recommended portion sizes of individual food/drink items, all of which presented these within food groups, in line with the Eatwell Guide.<sup>28</sup> All resources included food/drinks from the starchy, protein, dairy and fruit and vegetables groups and five resources (33%) included foods from the HFHS group. Eleven (50%) resources gave guidance for portion sizes of food/drinks within meals, 10 of which presented meals by eating occasion (breakfast, lunch, dinner and snacks). The two IFT (Infant & Toddler Forum) resources presented breakfast, main meals and snacks, and the Safefood resource presented 'composite meals'. Two of the First Steps Nutrition Trust (FSNT) resources were specific to only one eating occasion (snacks and packed lunches, respectively). One of FSNT resource, included vegan meals only. Sixteen resources (73%) presented portion sizes as a mixture of weights and household measures (spoons, cups, number of foods [e.g., ½ apple] and slices), and six (27%) presented portion sizes in weights (grammes, ounces and millilitres) only.

### 3.5 | How the guidance resources were informed

Information on how the portion size recommendations within each resource were informed was obtained (Table S2). This was requested from contacts for 17 (77%) of the resources, as the information was not supplied within the resources. This information was obtained from 16 contacts through two face-to-face meetings (one meeting with the author covered five resources), one phone call and nine email replies. One organization did not respond. From the data collected, expert opinion was most commonly used (13/22, 59%) to inform the portion size information within the resources, with many drawing upon expertise from dietitians and nutritionists.

Government Dietary Reference Values (DRVs) were also commonly used (12/22, 55%) to inform the portion sizes. In nine of the 11 resources that recommended meals, the DRVs for energy and nutrient requirements had been considered. For the Caroline Walker Trust (CWT), Public Health England (PHE), Welsh Government, Action for Children (AfC) and three FSNT resources, it was stated that portion sizes were based on meeting the requirements for those with the highest energy needs (3- to 4-year-olds). In addition, the meals within these resources were aimed at childcare providers providing preschool-aged children with 90% of their daily energy intake (20% breakfast, 10% morning snack, 30% lunch, 10% afternoon snack and 20% dinner). The ITF presented a range of portion sizes, with the lower range being suitable for a 1-year-old and the higher range being for a 4-year-old, and the HSE presented only portion sizes appropriate for a 5-year-old. Eight resources (36%) stated that nutrient analysis was conducted on the theoretical meals, to ensure nutrient requirements were being met across the meals each day for the whole age range.



Eight (36%) resources used portion size information from other existing resources. Figure S1 presents a hierarchical model illustrating which resources informed others. Three resources integrated information from one or more existing resources as a starting point for their own guidance: (1) The British Nutrition Foundation (BNF) used portion size information from the ITF in combination with expert opinion, an expert working group and the DRVs; (2) PHE used existing meals from the FSNT and Action for Children resources as the basis for some of their menu planning and (3) Safefood used portion sizes from DoH Ireland and CWT along with meal pilot testing and an expert working group. Five resources used the exact portion sizes from other resources. For example, the Welsh Government used the same 3-week menu plans as PHE and Bradford Nutrition and Dietetics Service used a combination of portion sizes from the CWT, ITF and British Nutrition Foundation resources.

## 4 | QUANTITATIVE DATA

### 4.1 | Resources that recommend portions sizes for individual food/drinks

Across the 15 resources that presented portion sizes for individual food/drink items, a total of 197 unique items were included (food = 190 [96%] and drinks = 7 [4%]). The only drinks included were milk and fruit juice. There was a large range in the number of items presented across resources; Bord Bia Irish Food Board (IFB) presented the lowest number of items (29), and FSNT presented the highest (111) (Table S3).

Table 2 presents the average portion size (g/ml) and energy content (kcal) of a food/drink item within each food group, as well as the variability across resources (indicated by pooling interquartile ranges of each food group across resources). Overall, the dairy food group had the largest median portion size and energy content, regardless of whether food and drinks were analysed together or separately. While the recommended portion of dairy drinks was larger than foods, the energy content of a portion was the same owing to the lower energy density of liquids. Dairy also had the highest variability in food portion size (IQR = 25–93 g). However, the highest variability in energy content was observed for protein (IQR = 44–106 kcal). Median portion size (grammes) was similar for fruits, vegetables, protein and starchy food groups. The vegetables food group had the lowest average energy content for a recommended portion, despite having a similar weight in grammes, as well as the lowest variability in portion size (IQR = 30–40 g) and energy content (IQR = 5–15 kcal). The HFHS food group had the smallest average portion size (grammes) but had a similar energy content per portion to dairy, protein, and starchy groups. Although the variability in average portion size between resources for HFHS was only 17 g (IQR = 11–28 g), this equated to a 52 kcal variability in energy content (IQR = 57–109 kcal).

Figure 2 presents the median portion sizes within each food group by resource (foods only). The figure shows that there was some variability in average portion size within resources for all food groups except for vegetables (shown by the error bars). The variability within resources was highest for dairy (57 g) and lowest for vegetables (9 g). When comparing individual resources, an 85 g difference was observed between the resources that recommended the highest average dairy food portion size versus the lowest (ITF 2016 vs. Bristol

**TABLE 2** Summary of the number of unique food and drink items, number of observations, average portion sizes and average energy content presented by food group for resources that present portion sizes for individual food/drinks

	Dairy	Fruit	Vegetables	Protein	Starchy	High fat/high sugar
Median (IQR) number of unique food and drink items included within resources						
	5 (5–6)	15 (8–19)	12 (3–24)	10 (7–21)	11 (8–18)	4 (3–11)
N observations <sup>a</sup> (%)						
Food and drinks (g or ml)	84 (9)	195 (22)	179 (20)	186 (21)	190 (21)	30 (3)
Foods only (g)	66 (7)	186 (21)	179 (20)	186 (21)	190 (21)	29 (3)
Drinks only (ml)	18 (2)	9 (1)	-	-	-	1 (0.1)
Median (IQR) portion size (g or ml)						
Food and drinks (g or ml)	66 (31–118)	40 (40–57)	40 (26–40)	40 (39–57)	41 (25–80)	20 (11–28)
Foods only (g)	60 (25–93)	40 (40–50)	40 (30–40)	40 (39–57)	41 (25–80)	18 (11–28)
Drinks only (ml)	125 (110–125)	100 (100–113)	-	-	-	110 (110–110)
Median (IQR) energy content (kcal) <sup>b</sup>						
Food and drinks	74 (59–93)	21 (15–33)	9 (5–14)	72 (44–106)	71 (56–106)	69 (52–109)
Foods only	73 (59–93)	20 (15–32)	9 (5–14)	72 (44–106)	71 (56–106)	69 (57–109)
Drinks only	74 (34–84)	38 (38–43)	-	-	-	42 (42–42)

<sup>a</sup>N observations refer to the total number of observations in the raw data set. Total N observations = 899.

<sup>b</sup>Calculated using energy values in National Diet and Nutrition Survey (NDNS) database (not extracted from original guidance resources) and grammes from guidance resources.



**TABLE 3** Summary of the number of unique food and drink items, number of observations, average portion sizes and average energy content presented by food group for resources that present portion sizes for food/drinks within meals

	Dairy	Fruit	Vegetables	Vegetable mixed dishes	Protein	Protein mixed dishes	Starchy	Starchy mixed dishes	High fat/high sugar
Median (IQR) number of unique food and drink items included within resources	4 (3–7)	10 (5–20)	11 (6–19)	4 (1–15)	3 (2–6)	6 (1–13)	10 (8–24)	2 (2–4)	6 (4–18)
N observations <sup>a</sup> (%)									
Food and drinks (g or ml)	71 (7)	196 (19)	158 (15)	118 (11)	50 (5)	119 (12)	169 (16)	30 (3)	111 (11)
Foods only (g)	54	191	158 (15)	118 (11)	50 (5)	119 (12)	169 (16)	30 (3)	111 (11)
Drinks only (ml)	17 (2)	5 (0.5)	-	-	-	-	-	-	-
Median (IQR) portion size (g or ml)									
Food and drinks (g or ml)	60 (20–100)	40 (36–40)	40 (30–40)	123 (90–145)	50 (45–95)	120 (90–156)	30 (20–53)	165 (80–190)	60 (35–75)
Foods only (g)	50 (18–60)	40 (30–40)	40 (30–40)	123 (90–145)	50 (45–95)	120 (90–156)	30 (20–53)	165 (80–190)	60 (35–75)
Drinks only (ml)	100 (100–100)	100 (100–100)	-	-	-	-	-	-	-
Median (IQR) energy content (kcal) <sup>b</sup>									
Food and drinks	62 (44–77)	20 (15–38)	10 (5–33)	98 (69–166)	85 (74–186)	165 (105–225)	76 (59–102)	210 (120–315)	78 (55–132)
Foods only	59 (44–80)	20 (15–38)	10 (5–33)	98 (69–166)	85 (74–186)	165 (105–225)	76 (59–102)	210 (120–315)	78 (55–132)
Drinks only	67 (67–67)	38 (38–38)	-	-	-	-	-	-	-

<sup>a</sup>N observations refer to the total number of observations in the raw data set, not the number of unique foods. Total N observations = 1,028.<sup>b</sup>Calculated using energy values in National Diet and Nutrition Survey (NDNS) database (not extracted from original guidance resources) and grammes from guidance resources.

**TABLE 4** Average total meal sizes in grammes and energy content in calories by eating occasion

Median (IQR) portion size (g or ml)											
Eating occasions	AfC 2017	CWT 2015	FSNT 2015	FSNT 2017	FSNT 2018	HSE 2016	ITF 2015	PHE 2017	Start4Life	Welsh Gov 2018	All
Breakfast	190 (174–194)	244 (194–255)	-	253 (235–263)	-	260 (260–260)	69 (37–117)	193 (165–205)	162 (119–178)	193 (165–205)	194 (165–219)
Main meal <sup>a</sup>											
Dessert	205 (175–215)	268 (223–290)	285 (260–350)	200 (185–260)	-	388 (388–388)	111 (106–119)	216 (193–230)	198 (198–211)	216 (193–230)	218 (193–248)
	80 (68–100)	100 (65–140)	-	80 (70–80)	-	-	58 (57–62)	81 (70–88)	-	81 (70–88)	80 (69–95)
Lunch	210 (200–240)	310 (290–320)	285 (260–350)	-	-	300 (300–300)	-	230 (220–255)	220 (206–223)	230 (220–255)	250 (220–285)
Dessert	100 (35–120)	100 (50–140)	-	-	-	-	-	95 (55–110)	-	95 (55–110)	98 (55–120)
Dinner	190 (150–200)	240 (140–270)	-	-	-	475 (475–475)	-	183 (140–210)	175 (170–215)	183 (140–210)	185 (143–218)
Dessert	100 (40–100)	100 (70–120)	-	-	-	-	-	83 (40–100)	-	83 (40–100)	85 (40–100)
Snacks	80 (74–116)	180 (170–204)	-	180 (170–185)	100 (80–113)	75 (50–100)	90 (53–208)	155 (90–171)	85 (70–90)	155 (90–171)	150 (90–178)
Average eating occasions <sup>b</sup>	240 (163–295)	292 (228–358)	-	253 (217–267)	-	280 (214–344)	90 (80–130)	230 (184–281)	169 (143–186)	230 (184–281)	235 (214–260)
Total grammes <sup>c</sup>	950 (747–1086)	1,354 (1,084–1,513)	-	1,173 (1,085–1,313)	-	1,260 (1,260–1,260)	587 (469–895)	1,094 (800–1,195)	727 (635–796)	1,094 (800–1,195)	1,094 (884–1,195)
Total energy content (kcal) <sup>d</sup>	1,301 (1,209–1,479)	1,293 (1,141–1,520)	-	1,329 (1,237–1,561)	-	1,293 (1,293–1,293)	1,002 (942–1,139)	1,258 (1,119–1,476)	919 (804–986)	1,258 (1,119–1,476)	1,276 (1,180–1,295)

Note. Average daily energy requirements for 1- to 2-year-olds are 850 kcal (girls) to 950 kcal (boys) and for 3- to 4-year-olds are 1,250 kcal (girls) to 1,350 kcal (boys).<sup>40</sup>

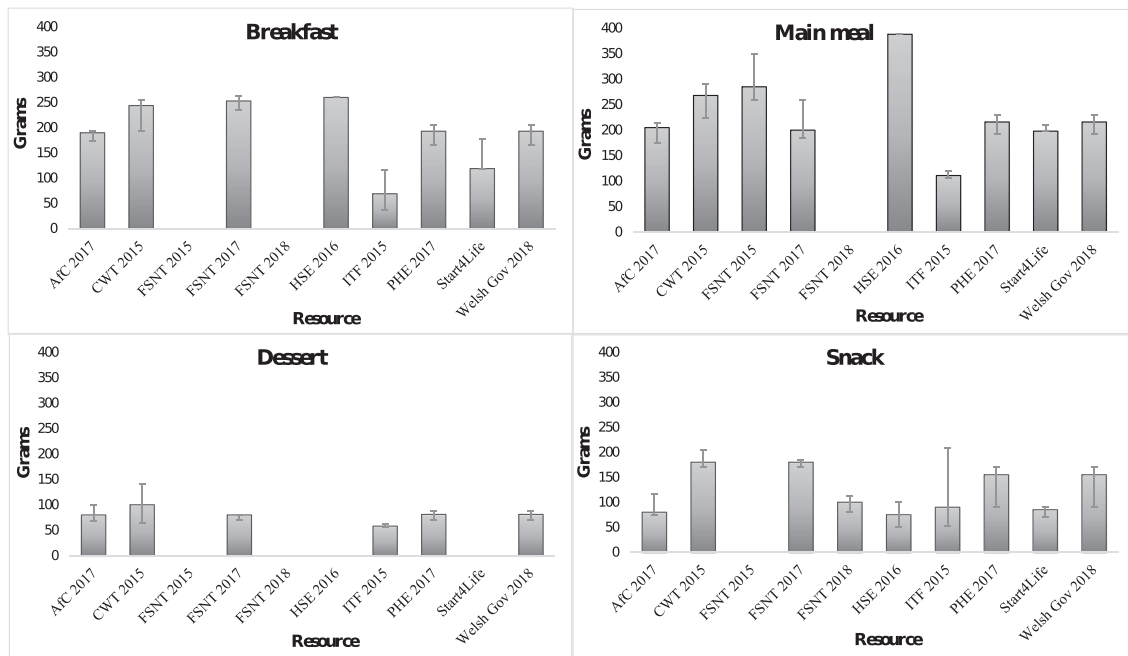
Abbreviations: AfC, Action for Children; CWT, Caroline Walker Trust; FSNT, First Steps Nutrition Trust; HSE, Health Service Executive; IQR, interquartile range; ITF, Infant & Toddler Forum; PHE, Public Health England.

<sup>a</sup>Where resources present lunch and dinner, the average of the two meals were calculated and presented as 'main meal' to aid comparability across resources.

<sup>b</sup>Calculated as median of all eating occasions (either breakfast, main meal, snack or breakfast, lunch, dinner or snack).

<sup>c</sup>Sum of breakfast, two main meals and two snacks, except for the HSE resource, which specified three snacks.

<sup>d</sup>The percentage of total daily energy intake that the guidance resources aim to achieve are as follows: AfC 90%; CWT 90%; FSNT 2017 90%, HSE 100%, ITF not stated, PHE 90%, Start4Life not stated and Welsh Gov 90%.

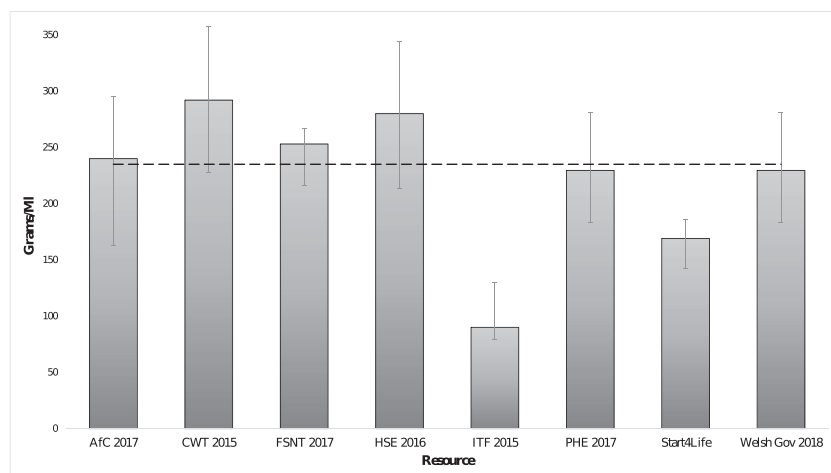


**FIGURE 3** Average total meal sizes by eating occasion. \*Where resources present lunch and dinner, the average of the two meals were calculated and presented as 'main meal' to aid comparability across resources. AfC, Action for Children; CWT, Caroline Walker Trust; FSNT, First Steps Nutrition Trust; HSE, Health Service Executive; ITF, Infant & Toddler Forum; PHE, Public Health England

main meals and snacks and shows that the portion size of a dessert tends to be more consistent across resources that include them. The largest difference was observed for the portion size of dinner: a 300 g/344 kcal difference between Start4Life (195 g/175 kcal) and HSE (475 g/519 kcal) (Tables 4 and S6).

Table 4 shows that as a result of the variability in meal sizes between resources, variability in the average total daily grammes and calories of food and drink recommended was also observed. Based on all resources recommending breakfast, two main meals and two to three snacks (specified by resource), the ITF and Start4Life resources recommend much lower total daily amounts (587 g/1,002 kcal and 727 g/919 kcal, respectively) than the other resources, in particular compared to the CWT and HSE resources (1,354 g/1,293 kcal and 1,260 g/1,293kcal, respectively).

Figure 4 presents the median portion size of any given eating occasion by resource. The median portion size of an eating occasion across all resources was 235 g (IQR = 214–260). The energy content equivalent was 271 kcal (IQR = 238–292). Again, CWT and HSE recommended larger than average portion sizes for any given eating occasion (292 and 280 g, respectively) and ITF and Start4Life recommended lower than average (90 and 169 g, respectively). To compare to resources that recommended portion sizes for individual food/drinks, we combined the median portion sizes of one dairy, one fruit, one vegetable, one protein and one starchy food/drink item (in line with the Eatwell Guide<sup>28</sup>) to calculate average portion size of an eating occasion. The median portion size of an eating occasion for resources that recommended portion sizes for individual food/drinks was 227 g (IQR = 161–352), and the energy content equivalent was



**FIGURE 4** Average portion size of an eating occasion by resource. \*Dotted line represents the average meal size of an eating occasion across all eight resources. Excludes FSNT 2015 and FSNT 2018 resources because they only present one type of eating occasion. AfC, Action for Children; CWT, Caroline Walker Trust; FSNT, First Steps Nutrition Trust; HSE, Health Service Executive; ITF, Infant & Toddler Forum; PHE, Public Health England

247 kcal (IQR = 179–353). These were similar to resources that recommended portions sizes for food/drinks within meals.

## 5 | DISCUSSION

This is the first systematic grey literature review to identify and collate the existing portion size guidance resources for feeding preschool-aged children (1–5 years) in the United Kingdom and Ireland. The review aimed to describe the target audiences, how resources were informed and the consistency of the portion sizes between resources. Our results showed that there are 22 resources available that target specific audiences (childcare providers, parents/carers and health professionals). Some similarities can be drawn between the resources, such as the focus on an age range (1–4 or 1–5 years) rather than a specific age and the use of food groups to present the recommended portion sizes of foods and drinks. However, several differences were also observed, such as how resources were informed, the recommended portion sizes and energy content of some food groups and eating occasions and whether portion sizes were presented as individual foods or as meals.

There are two main reasons why child feeding and portion size guidance are important for this age group and therefore why reviewing the current guidance is paramount. The first being to ensure optimal growth and development (physical and cognitive) and avoid deficiencies. A healthy diet (which guidance resources often promote) can help to achieve this through providing sufficient energy and nutrients.<sup>31</sup> In addition, if a healthy diet is promoted at a young age, this is more likely to track into adolescence and adulthood.<sup>32, 33</sup> The second reason is to prevent excessive weight gain, which could lead to overweight and obesity<sup>34, 35</sup> and increased risk of co-morbidities.<sup>36</sup> A study by Syrad et al.<sup>13</sup> found that in a UK twin birth cohort, a small (10 kcal) increase in meal size at 21 months was associated with a 4% faster growth rate above the average, demonstrating that increasing meal size was associated with more rapid weight gain.

Experiments show that young children are susceptible to consuming more when served larger portion sizes.<sup>37</sup> However, parents tend to be more concerned about feeding young children enough and a variety of food rather than too much.<sup>38</sup> Following appropriate portion size guidance for meals may be particularly important for parents because there is evidence that parents often decide how much to serve their child based on instinct, previous experience and how much they serve themselves.<sup>39</sup> The guidance we have identified could form the basis for advice to caregivers to help maintain a healthy weight status in preschool-aged children.

Twenty-one of the included resources recommended portion sizes for an age range (1–3, 1–4 or 1–5 years). Of these, 13 resources presented one portion size for each food or drink item. While this portrays a simple message, it suggests to caregivers that the portion sizes do not vary with age (i.e., that a 1-year-old needs as much energy as a 5-year-old). In contrast, in order to meet the energy needs for healthy growth, daily energy intake should increase from 850/950 kcal/day at ages 1–2 years to 1,250/1,350 kcal/day at ages 4–5 years in girls and

boys, respectively.<sup>40, 41</sup> It may be more appropriate to recommend a portion size range (as eight resources did), emphasizing that the lower end is more appropriate for younger children as this may help prevent unintentional overfeeding of younger children.

Portion sizes in the resources were presented as either individual food or drink items or as combinations of foods within meals. A meal-based approach tended to be aimed at childcare providers and included weekly menus. This may be more practical for childcare providers to use as they could replicate the weekly menus included in the guidance and serve the recommended portion sizes. Where resources were targeted at parents, individual food portion sizes tended to be presented rather than meals. This may be more practical for parents as they can flexibly construct a meal from a range of food items and learn the recommended portion size for each. However, using this type of guidance may be more difficult to implement when serving composite meals (e.g., lasagne) for a whole family. In addition, knowledge about how to combine different food groups to make appropriately sized and balanced meals is required when translating individual food-based guidance into practice, which may be a source of error in implementation for users of the guidance. Therefore, it is important for resources to also give guidance on how portion sizes of foods and drinks can be combined to serve appropriately sized meals to make guidance easier to translate into practice.

We showed that the portion size of an average eating occasion was similar for meal-based versus individual food-based guidance, but the variability in total meal size was much wider for guidance given on individual foods (235 [IQR = 214–260] and 227 g [IQR = 161–352], respectively). Both meal- and food-based estimates for total meal size were similar to the median intake of food at an eating occasion in NDNS at 232 g (Table S7). We did however observe variation between resources that provided meal-based guidance. The difference between the largest average main meal (388 g/421 kcal) and the smallest average main meal (169 g/202 kcal) was large (difference = 219 g/219 kcal). We also observed similar differences in average total daily intake; the difference in grammes between the resources that recommended the lowest and highest total daily intake was 767 g (410 kcal). Evidence suggests that a small daily positive energy balance of 70–160 kcal above the total energy required for adequate growth could lead to gradual excessive weight gain in children.<sup>42</sup> The variation in recommended meal sizes across different resources could, if followed, lead to different energy intake and subsequent weight outcomes over time (assuming physical activity remains constant). Although, we estimate that all meal-based guidance resources recommended total daily energy contents (kcal) within the World Health Organization (WHO) daily energy requirement recommendations for 4- to 5-year-olds,<sup>40</sup> some resources would need to be used flexibly to not exceed the requirements for younger children.

We observed the greatest variability in portion size across resources in the dairy food group (IQR = 68 g), however, this only equated to a variability of 34 kcal. This may in theory influence the risk of obesity, as dairy foods tend to be calorie rich, however, a recent systematic review suggests that dairy intake is not a determinant of obesity in children.<sup>43</sup> In contrast, variability in portion size of



the protein food group was relatively small (IQR = 18 g), however, this equated to a 62 kcal variability across resources. This variability in energy content may be due to the inclusion of both animal and vegetable protein foods. As higher animal protein intake may be associated with later obesity risk in children,<sup>44</sup> guidance may need to carefully consider appropriate portion sizes for animal versus vegetable protein sources. On the other hand, fruit and vegetable portion size recommendations and energy equivalents were much less variable (IQR = 10 g/17 kcal and 10 g/9 kcal, respectively). Fruit and vegetable recommendations may be more consistent across resources because of the long-standing public health message that five portions (of 80 g for adults) of fruit and vegetables should be consumed each day.<sup>45</sup> Guidance has tended to half this portion size for preschool-aged children (median recommended portion size was 40 g for both fruit and vegetables). However the UK 5-a-day campaign states that a child's portion will vary with age and body size.<sup>46</sup> Therefore, portion size guidance we identified may be oversimplifying this recommendation, which may need to be more age specific.

The portion size and energy content variation we observed in some food groups between resources may partly be explained by the variety of recommended foods, as the same list of foods was not included in every resource. However, it may also suggest that recommended portion sizes of the same foods are not consistent across resources. This is in line with research conducted comparing recommended portion sizes for adults, from UK schemes, which also observed significant discrepancies for several foods in the starchy and protein food groups but consistency for fruit and vegetables.<sup>47</sup> A lack in consistency, which creates confusion, may be an important reason why some parents do not use existing guidance.<sup>38</sup>

Only 11 of the 22 resources included guidance on HFHS foods. The World Health Organization recommend that energy-dense, nutrient-poor foods should be avoided,<sup>48</sup> therefore, the absence of guidance on HFHS foods is designed to discourage caregivers offering these foods at all. However, in an obesogenic environment with high availability of HFHS foods,<sup>49</sup> which are highly liked by children,<sup>50</sup> guidance for caregivers on appropriate limits for HFHS foods could be beneficial. A study by More and Emmett<sup>51</sup> that created a daily food plan to meet the UK DRV's for 1- to 4-year-olds estimated that cake and biscuits/cookies could only be eaten once per day and confectionary, savoury snacks and sweet drinks once per week. Complete restriction of palatable energy-dense foods by parents has been associated with increased preference for these foods, increased eating in the absence of hunger and higher weight status in young children.<sup>52</sup> In addition, our results suggested that a small variability in portion size of a HFHS food (IQR = 17 g), equated to a larger variability in energy content (IQR = 52 kcal), suggesting that a small increase in portion size has important implications for energy intake. Therefore, guidance recommending appropriate limits for the portion size and frequency of HFHS foods may help parents and caregivers to strike a healthy balance.

According to the information we obtained, the resources were commonly informed by expert opinion, DRVs, nutrient analysis or existing resources, with 18 resources using more than one method.

Studies have shown that 1- to 4-year-olds do not currently meet the recommended nutrient requirements in the United Kingdom<sup>53</sup> and Ireland.<sup>54</sup> However, the overall effect on weight of meeting multiple DRVs has not been explored in a longitudinal cohort study or trial. It is therefore unknown whether following DRV-based portion size guidance would lead to optimal weight gain. Moreover, the Scientific Advisory Committee on Nutrition lowered DRVs for nutritional requirements in children up to 10 years in 2011<sup>55</sup> and the limit on free sugar intake for children over 2 years in 2015.<sup>56</sup> Resources published before 2015 may not meet current requirements, emphasizing the need for regular updates.

## 5.1 | Implications

Previous research suggests that parents are unaware of existing portion size guidance.<sup>18</sup> This review can help identify suitable portion size guidance for different target audiences, as well as explore improvements to ensure resources support caregivers in translating advice into practice, to avoid excessive weight gain and nutritional insufficiency in children.

This review adds to the current Infant & Toddler campaign in the United Kingdom,<sup>57</sup> in raising awareness of portion size guidance to support parents in serving appropriate portion sizes to their children. The extracted quantitative data could be used in future analyses to assess whether children adhere to recommendations, by comparing portion sizes within the resources with national survey data.

Raising awareness and developing portion size guidance may be particularly important in other countries, where 'supersizing' of food and drinks is common, such as in the United States.<sup>58</sup> Downsizing policies are required to help tackle the portion size effect and its consequences for childhood obesity in many countries<sup>59</sup> and evidence-based guidance is required to underpin successful interventions. The methods of this review could be replicated for other countries where childhood obesity rates are a concern, to assess guidance adequacy. Where more guidance is required, this review has identified UK resources that could be adapted to suit cultural norms around types of food and meal patterns in other settings.

## 5.2 | Strengths and limitations

This is the first time that a review has systematically identified all available portion size guidance resources for preschool-aged children in the United Kingdom and Ireland. The focus on grey literature allowed us to identify guidance resources with potential to be found by childcare providers, which would not have been identified in academic journals (typically unavailable to the general public) and the use of experts to identify possible resources strengthened the search strategy. The use of the NDNS food coding system allowed comparison of resources in a systematic and consistent way. We did not report on the quality of each resource because there is currently no framework to assess the quality of portion size guidance. Our review



highlights the need for a framework to be developed to ensure evidence-based and effective guidance is being created. The use of the food code book to convert weights from household measures to grammes or millimetre and use of the NDNS database to calculate energy densities may have led to an under or over estimation of some portion sizes and energy densities, but we do not believe this caused a systematic difference across foods or resources. The search strategy mainly focused on online resources, and so we may have missed physical resources that are not published online. We aimed to ensure that all the most up-to-date resources were included at the time of searching, but it is possible that new or updated resources have since been published.

## 6 | CONCLUSIONS

This review identified 22 guidance resources that caregivers could follow to provide appropriate portion sizes for children aged 1–5 years. Key variations in portion size guidance were observed that raise questions for future research: Should guidance be food-based or meal-based for certain target audiences? Should guidance be age specific to ensure healthy weight gain? Should guidance include high-fat, high-sugar foods and drinks? What guidance format is most accessible for use by parents/carers? Our review provides the basis for improvements to ensure foods are combined to make appropriately sized meals for optimal growth and that guidance is appealing to users and easy to implement.

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## CONFLICT OF INTEREST

No conflicts of interest were declared.

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## SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of this article.

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